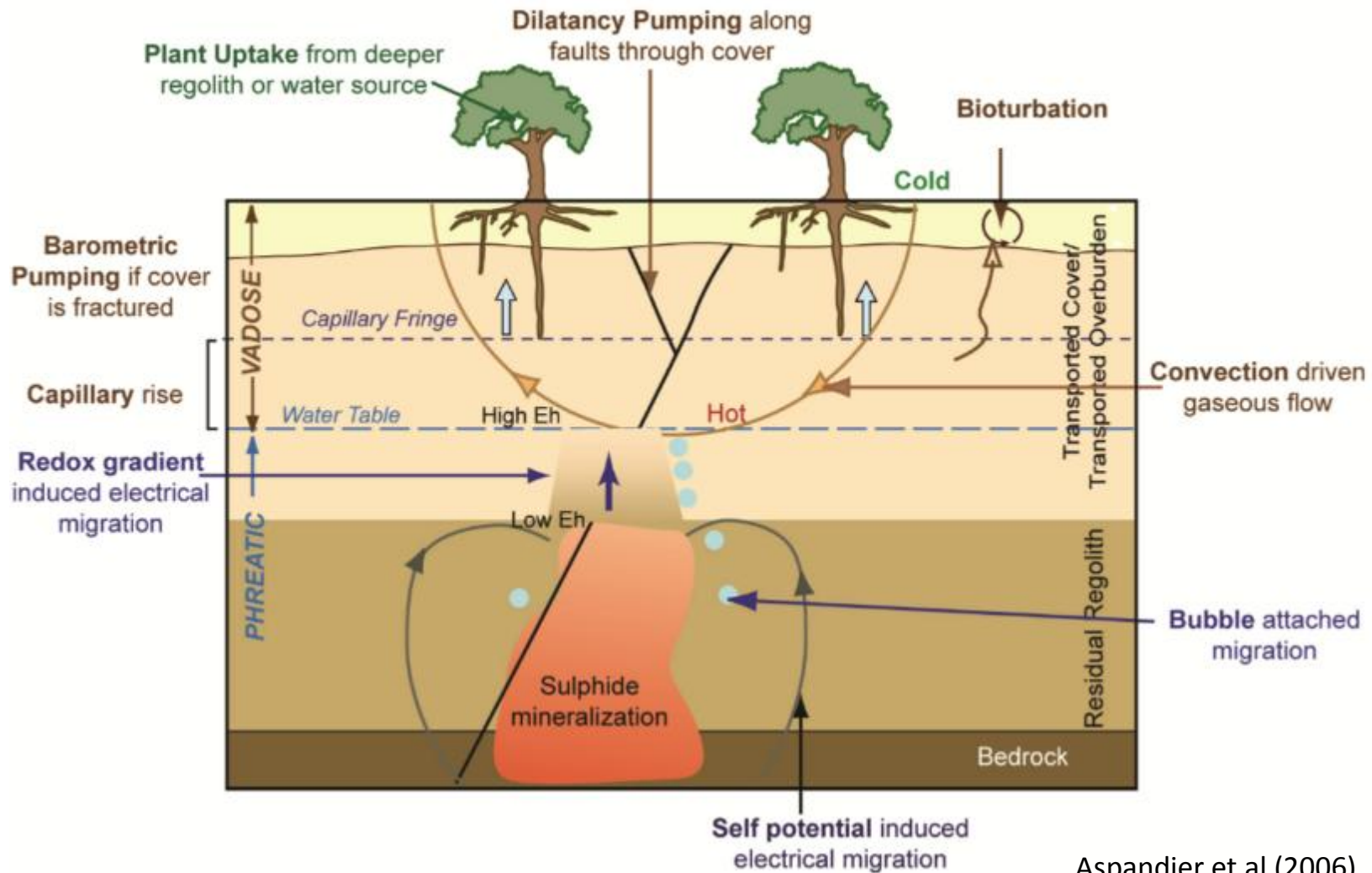


**Sizing up the Footprint:  
Concepts in Regional Scale Undercover  
Geochemistry.**

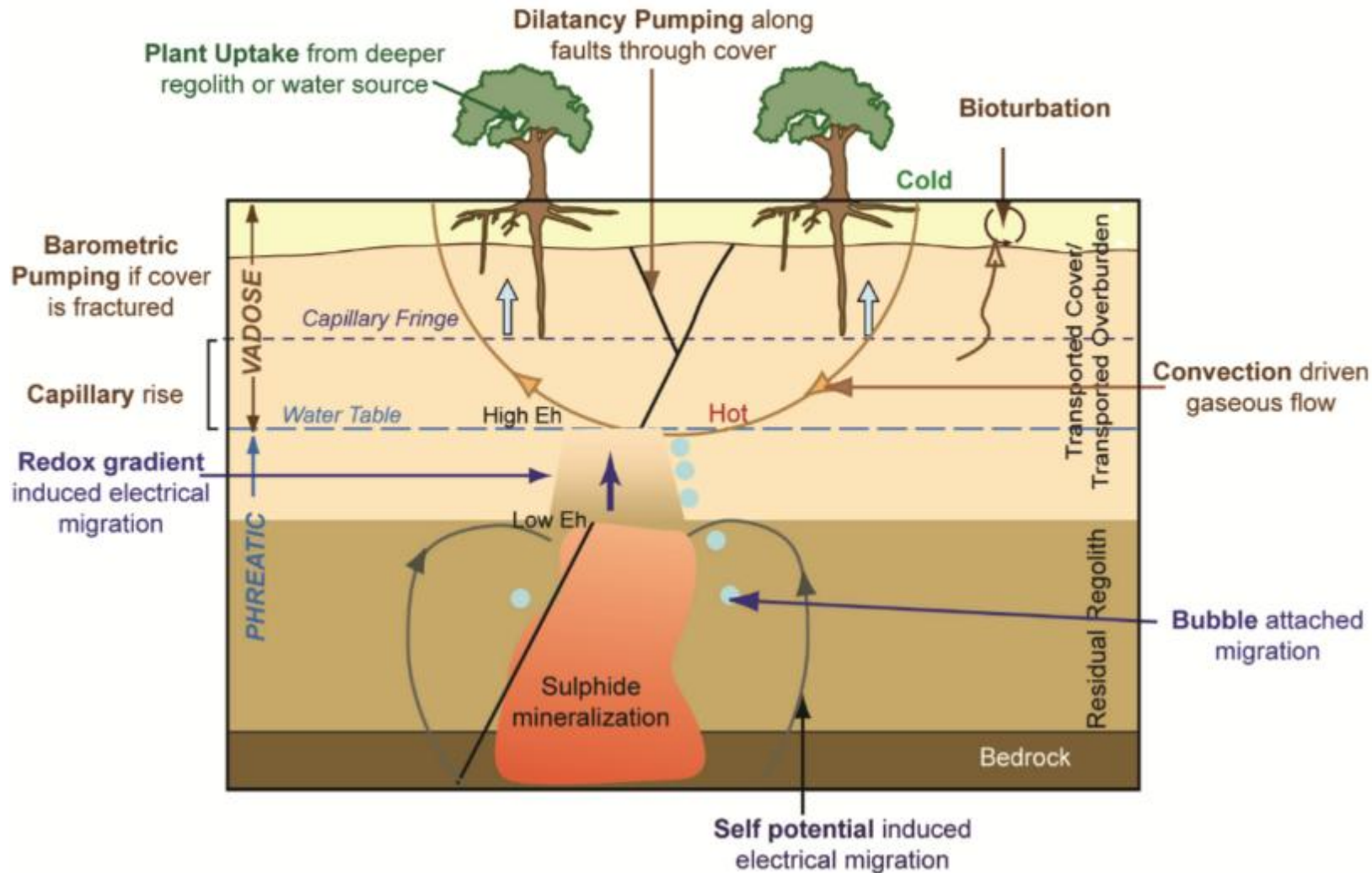
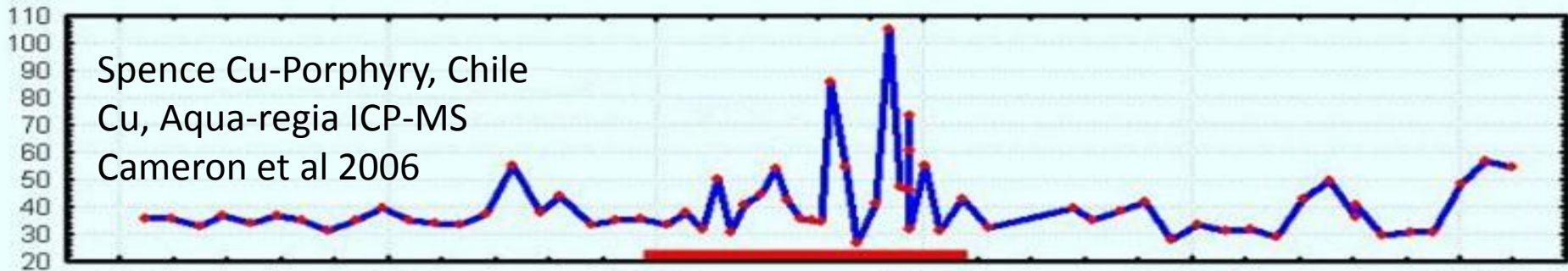
**Dr. Peter Winterburn  
Research Chair in Exploration Geochemistry.**

# Opportunities

- Discover the next round of mineral deposits:
  - Lacking outcropping mineralisation,
  - Lacking significant outcropping alteration,
  - Extremely weathered,
  - Extremely leached,
  - Buried under younger formations,
  - Buried under transported overburden,
  - Combinations of the above.





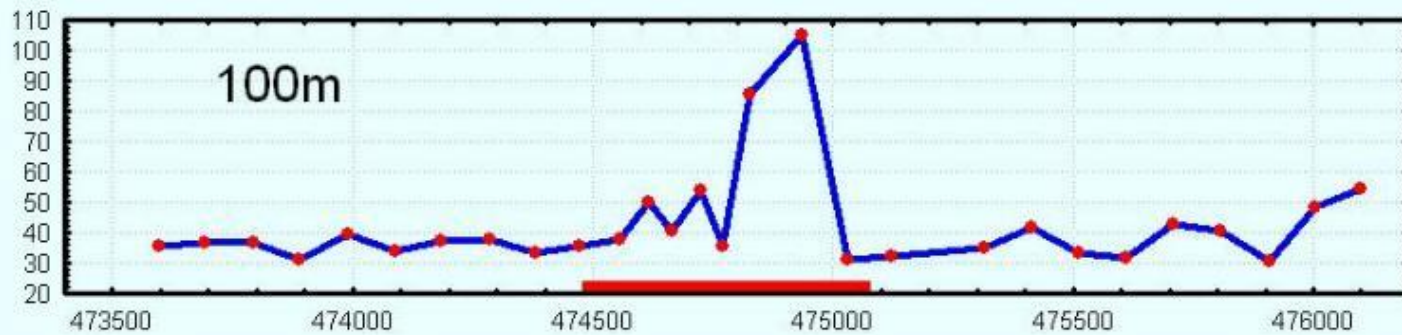
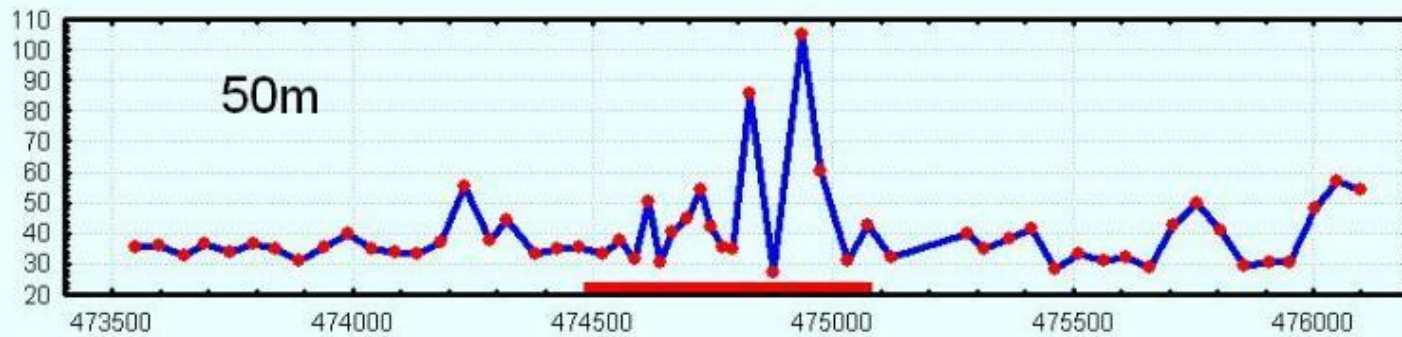
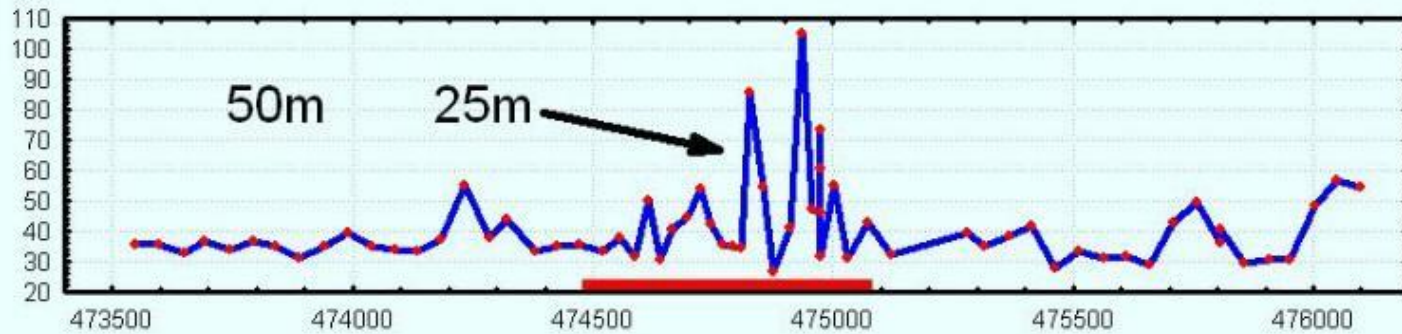


# Ore Footprints.

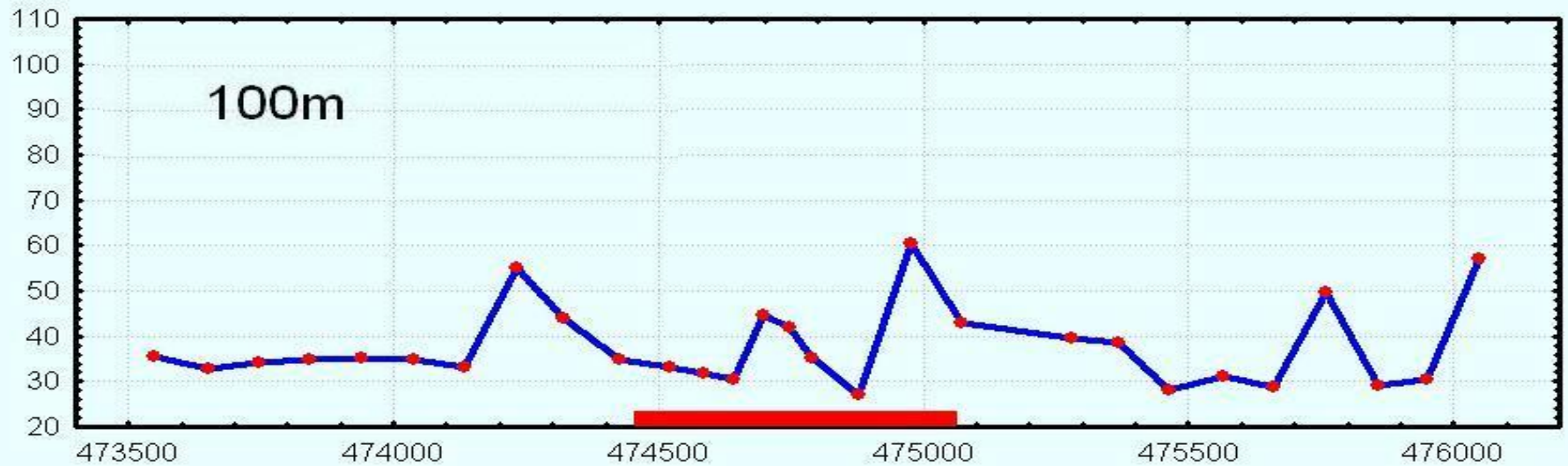
- Majority of commercial selective geochemical techniques are for target discrimination
  - Enzyme leach
  - Ionic Leach
  - BioLeach<sup>(BB)</sup>
  - Regoleach<sup>(BB)</sup>
  - MMI<sup>(BB)</sup>
  - SGH<sup>(BB)</sup>
  - Distilled water
  - Weak aqua-regia
  - Hydroxylamine

(BB) = Black Box

# Cu ppm – aqua-regia ICP-MS



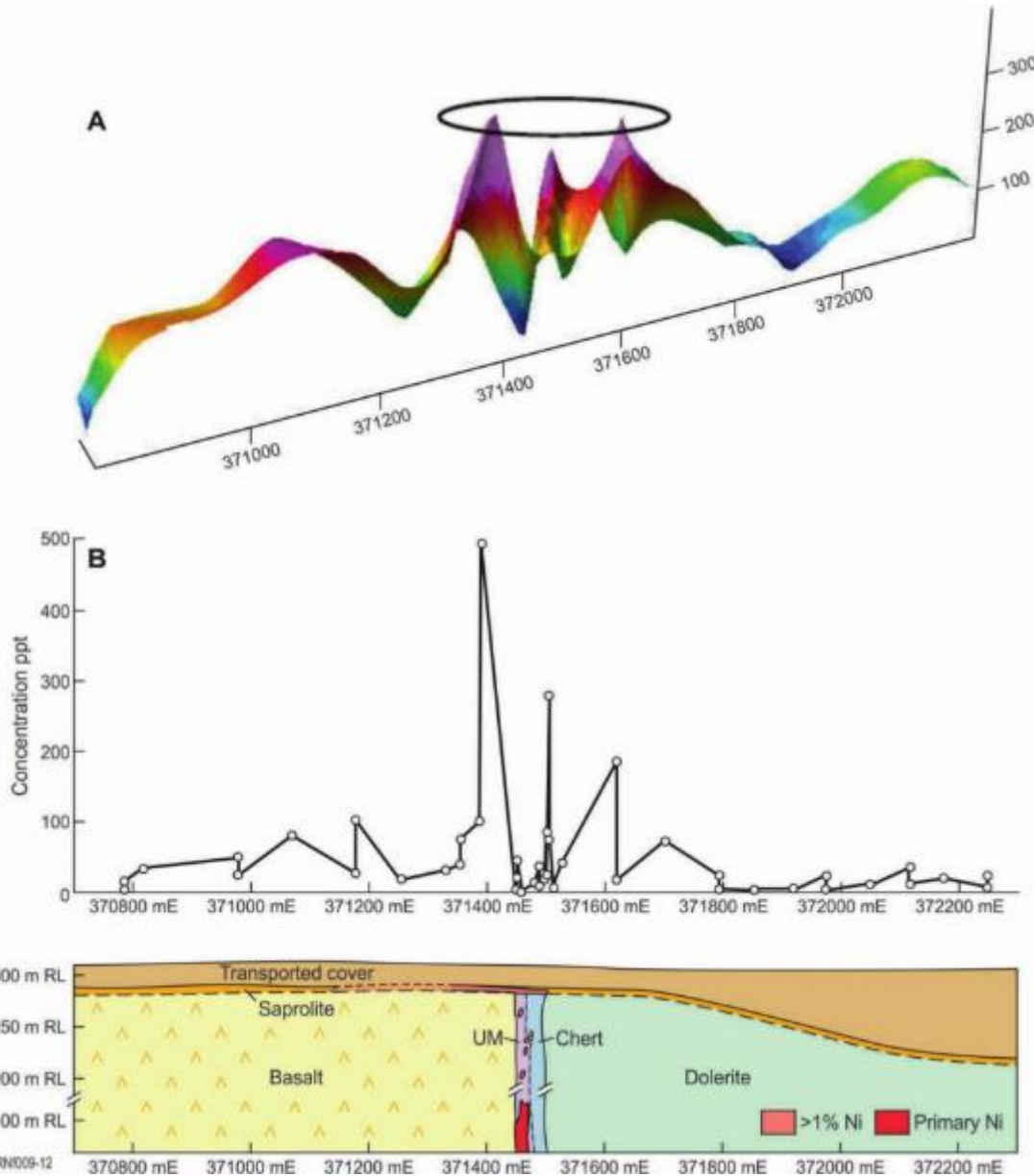
# The “other” 100m



# North Miitel Ni sulphide deposit, S Yilgarn, Aus. SGH

“By using the raw data and selecting seven unknown compounds (out of 162) that showed anomalous responses anywhere towards the centre of the traverse, we created an index (the 7 compounds were multiplied together). The result of this index is quite similar to the Actlabs reported results. Thus we were able to simulate the Actlabs report without knowledge of the reported organic compounds. **A successful result was generated just by guessing roughly where the mineralisation occurs – typically towards the middle of an orientation traverse ..**”

Noble, Lintern, Townley, Anand, Gray, & Reid (2013).





# Challenges

- None-robust signals
- Poor reproducibility
- Poor signal : noise distinction
- High Sampling Density

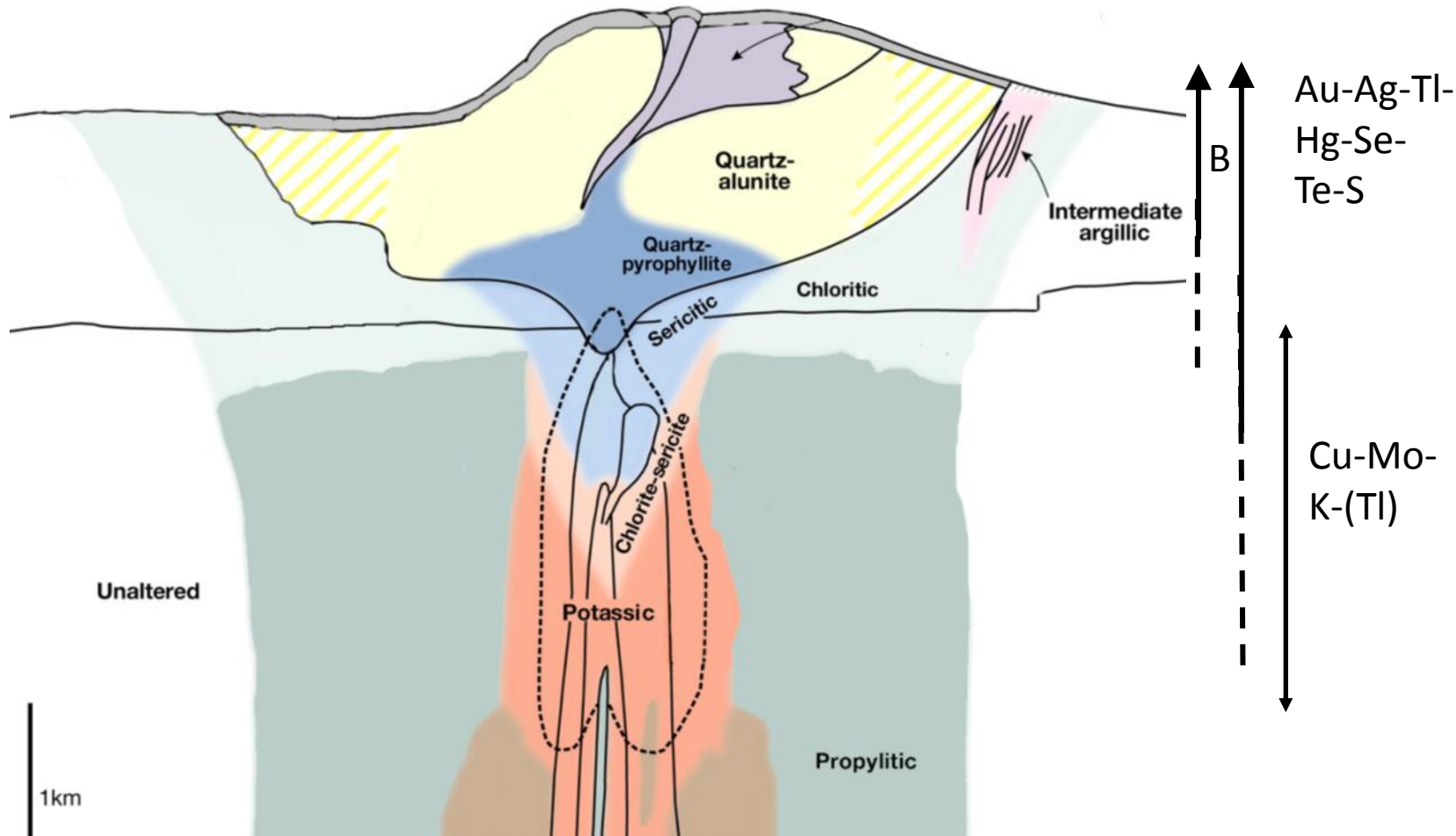
# Challenges

- None-robust signals
- Poor reproducibility
- Poor signal : noise distinction
- High Sampling Density
- Poor knowledge of processes
- Poor knowledge of response residency
- Poor understanding of chemistry
  - Soil Chemistry
  - Leach chemistry

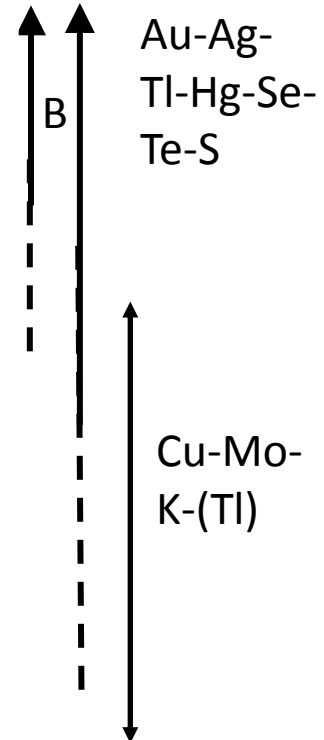
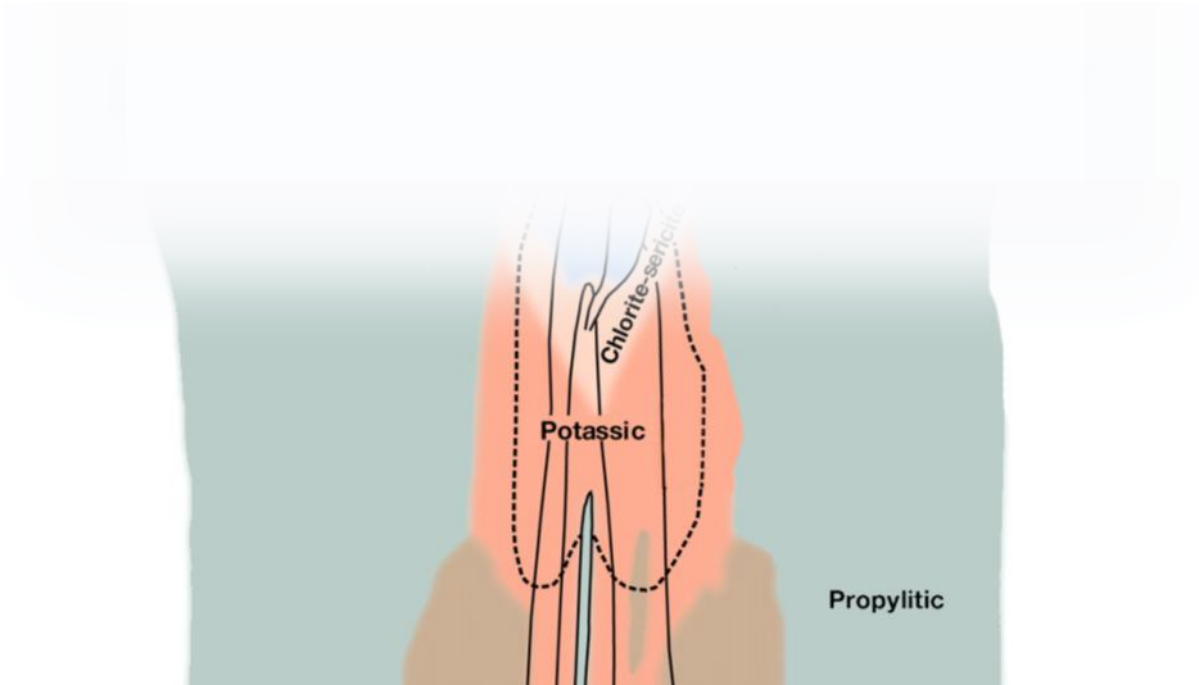
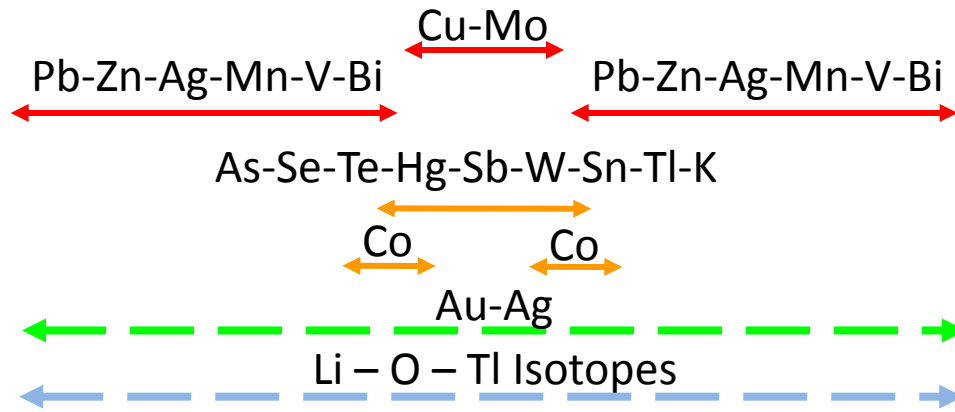
# Regional Scale

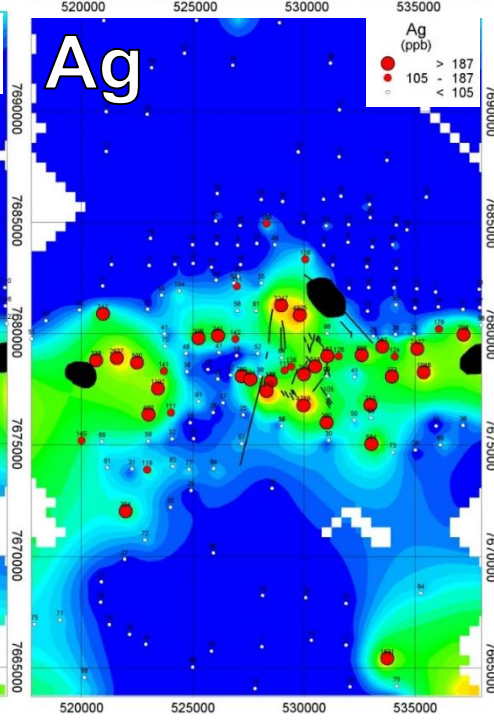
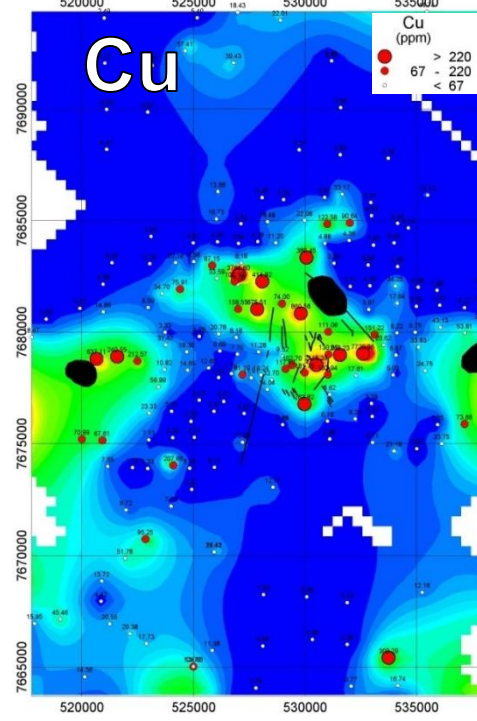
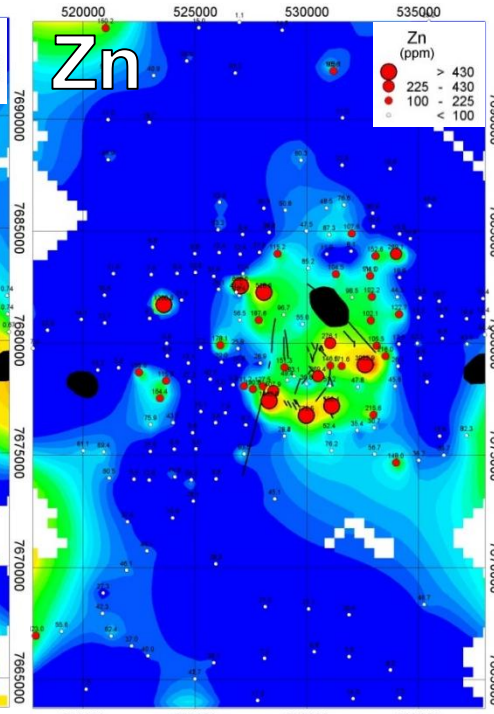
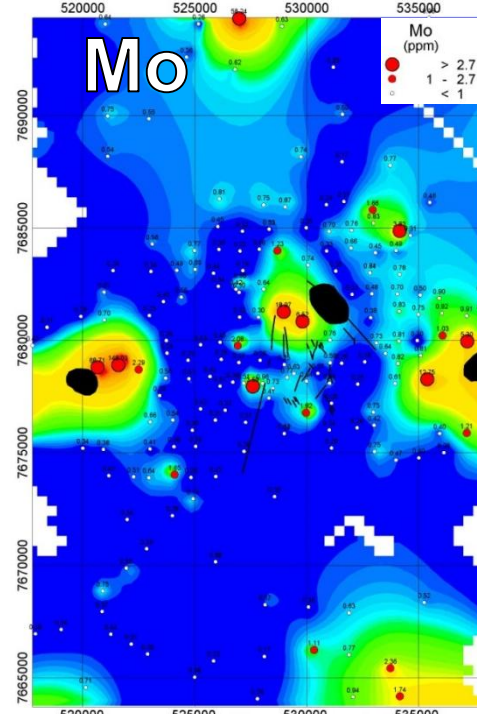
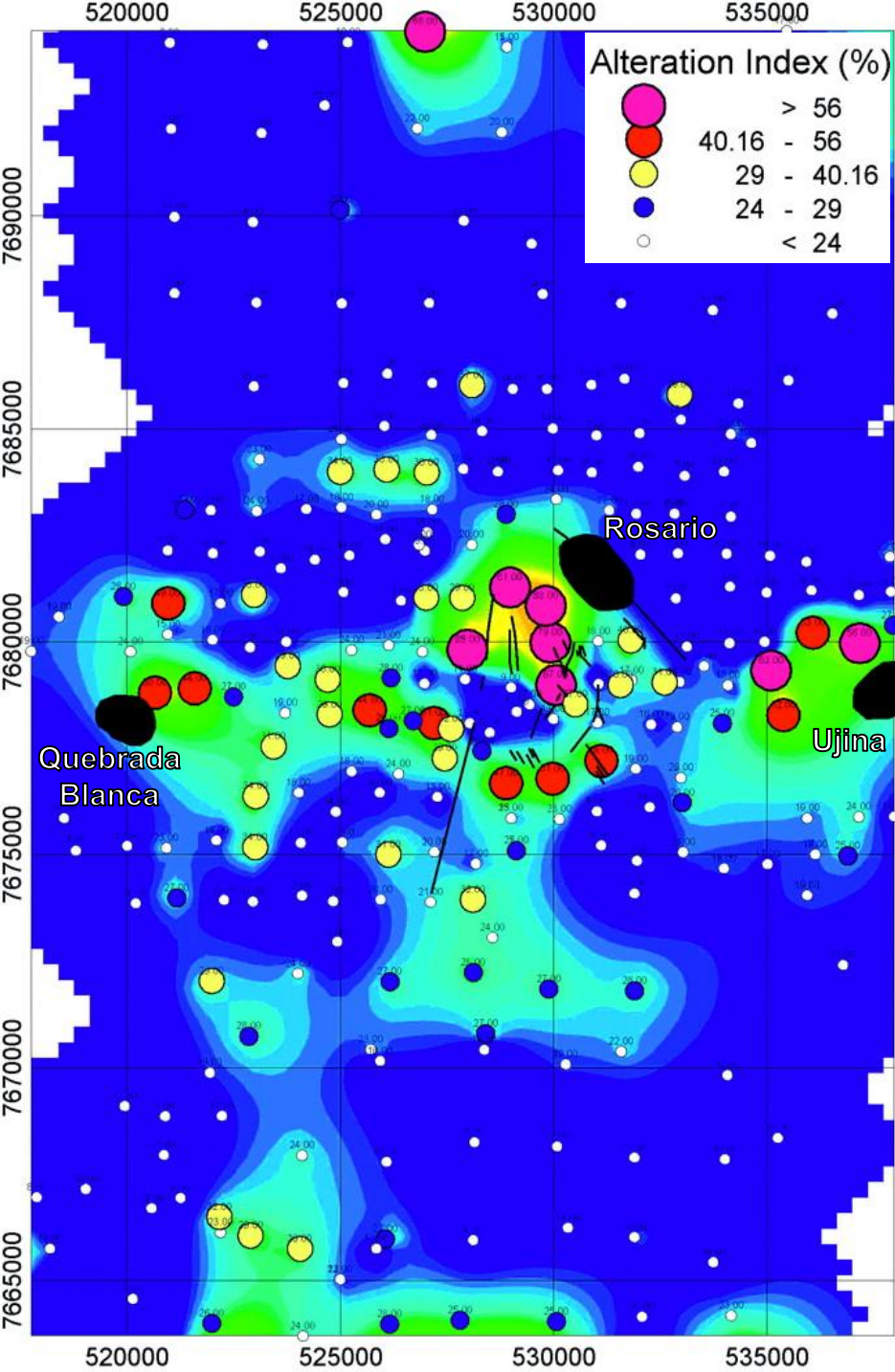
- Required sampling density too high for regional scale exploration.
- Methods not sufficiently robust enough.
  - False positives
  - False negatives
- Environmental and background variability – much more unforgiving.
  - Regolith,
  - Topography
  - Geology

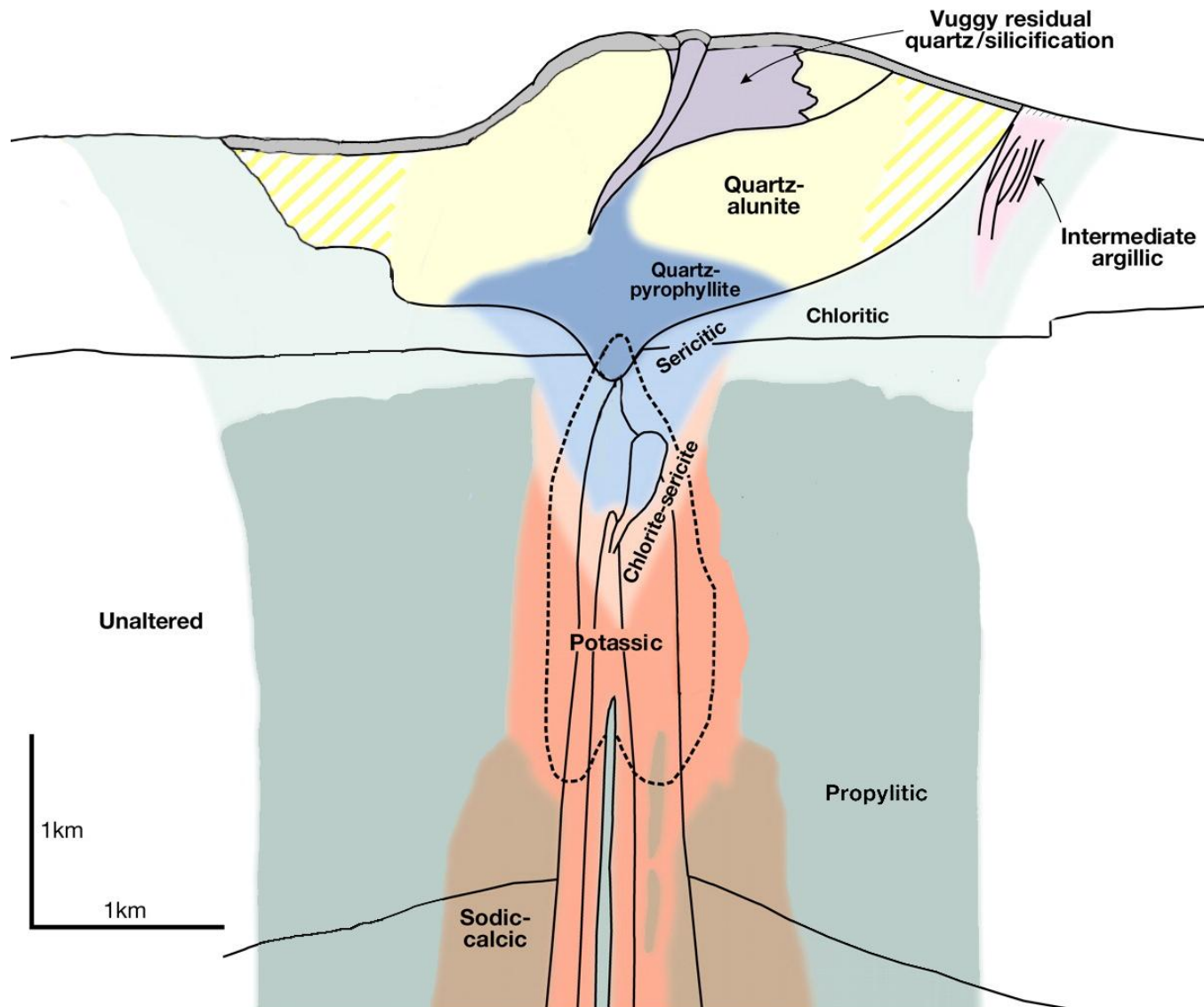
# Residual terrains





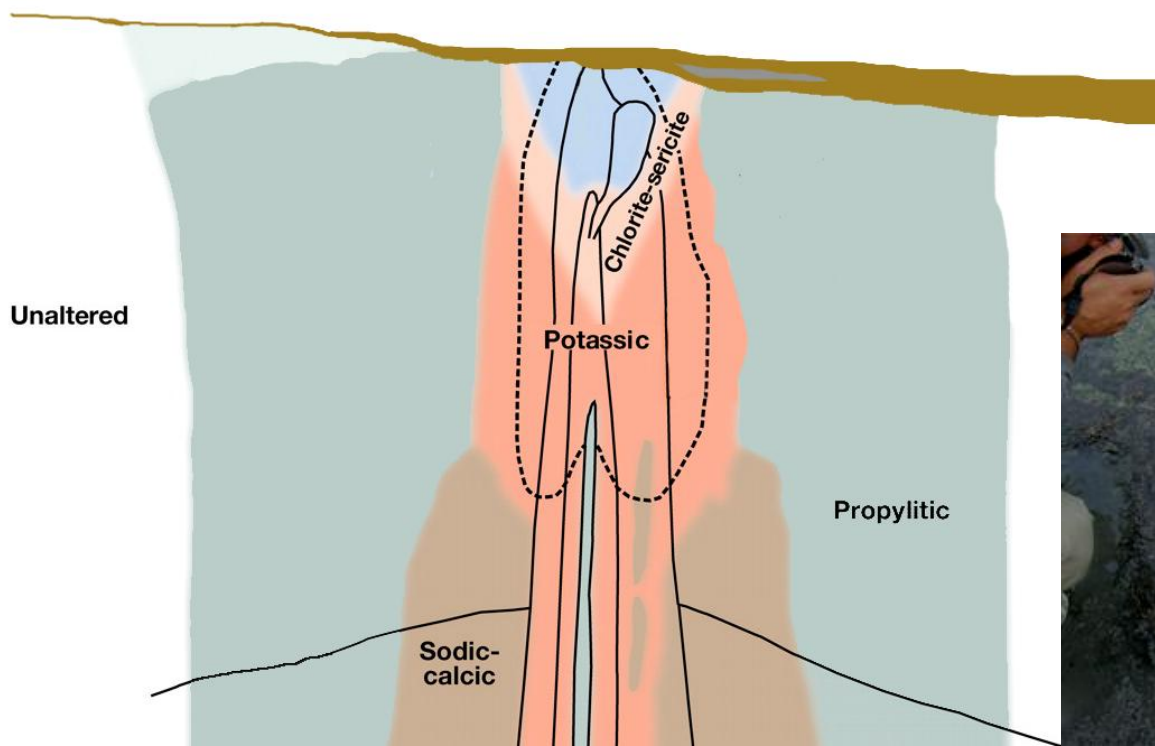
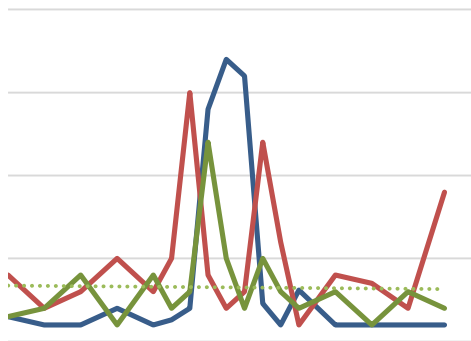






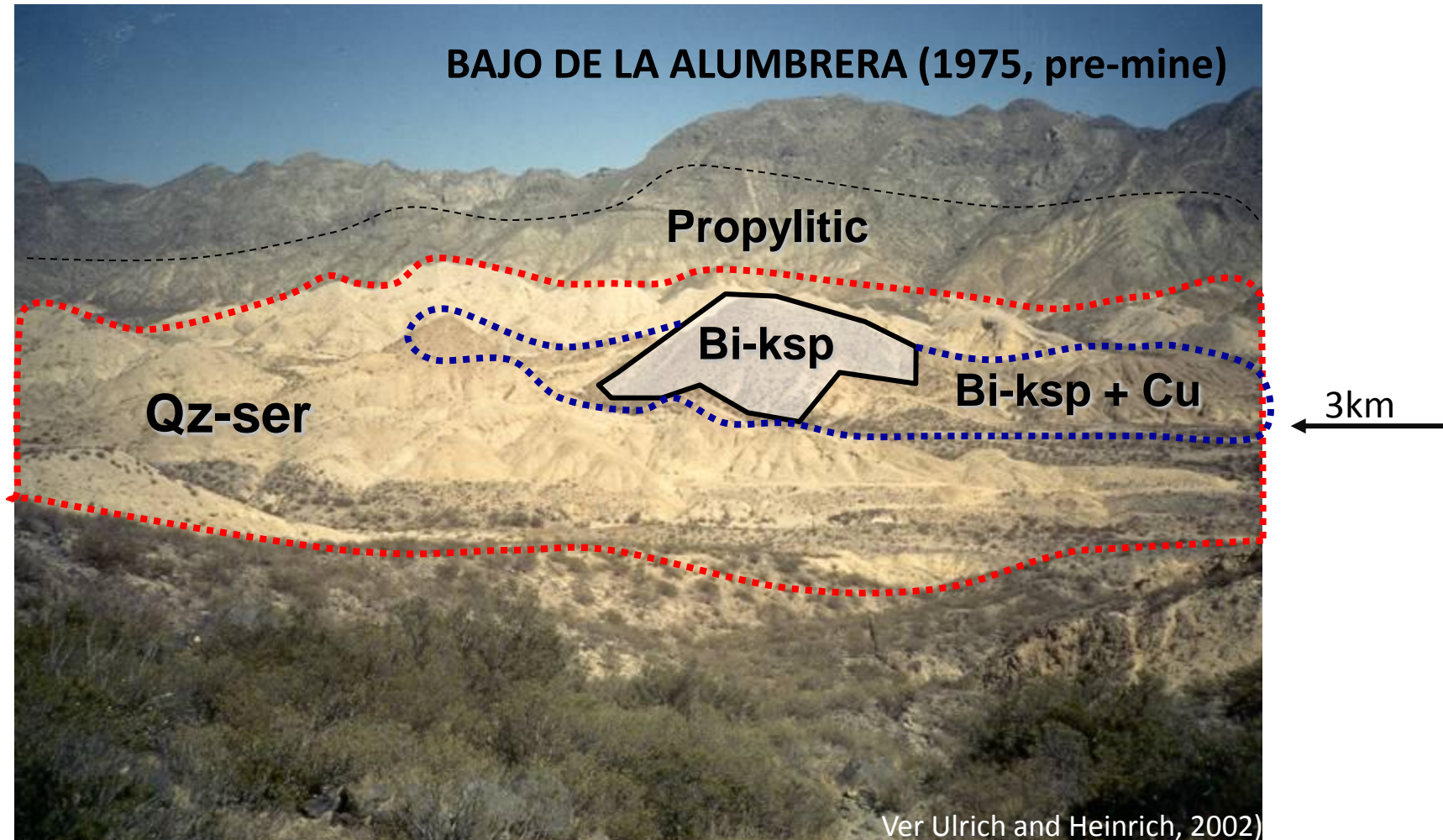


# Organics/inorganics/electrical/biological/isotopes



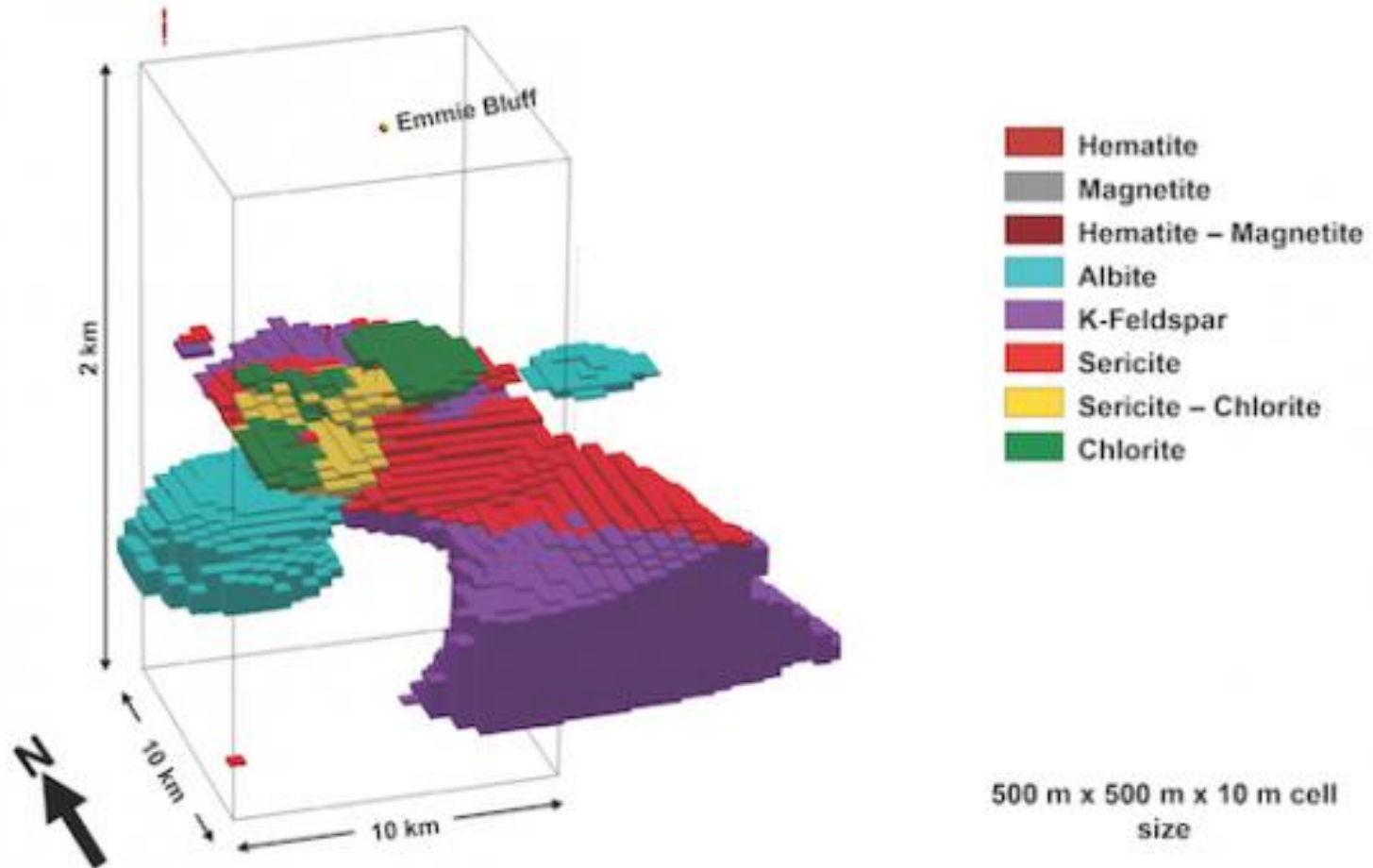


# Porphyry alteration



# IOCG alteration model

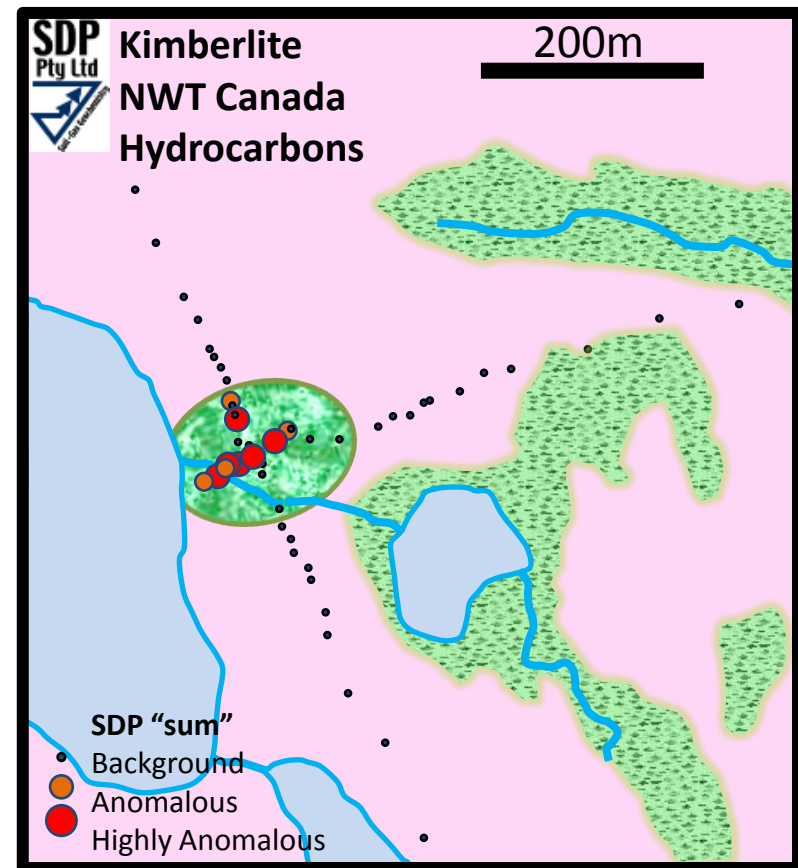
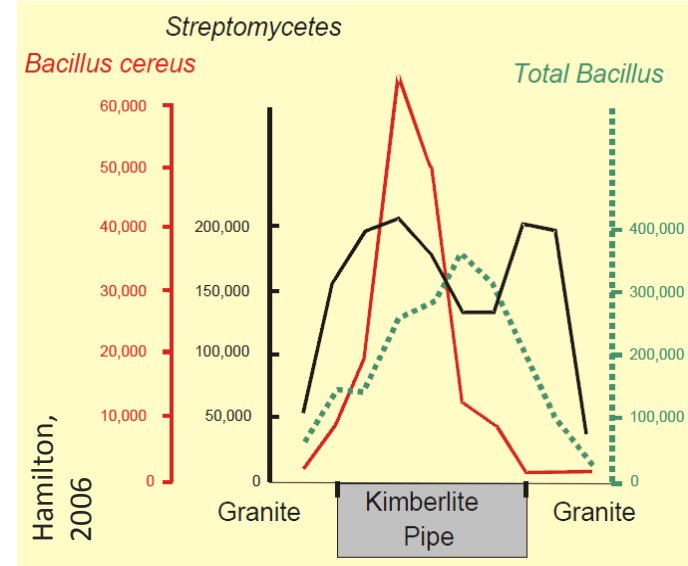
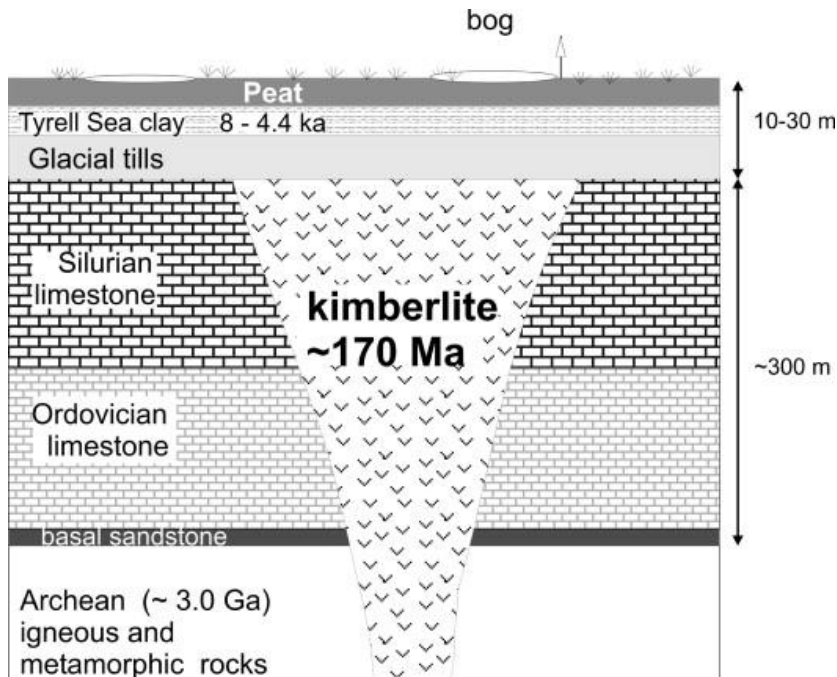
## Emmie Bluff 3D Model



10x vertical exaggeration

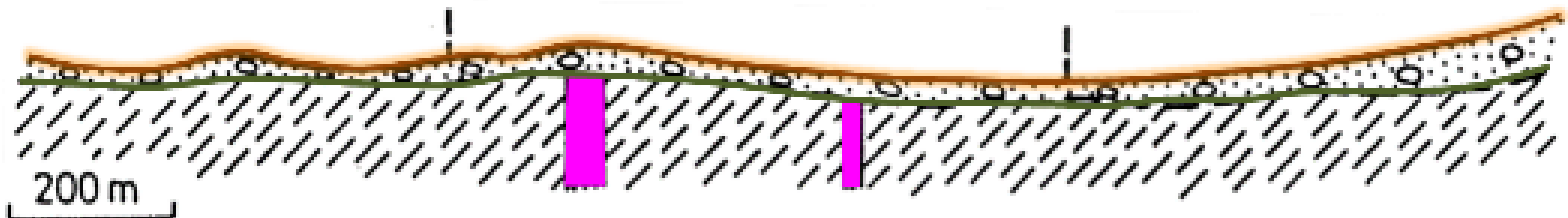
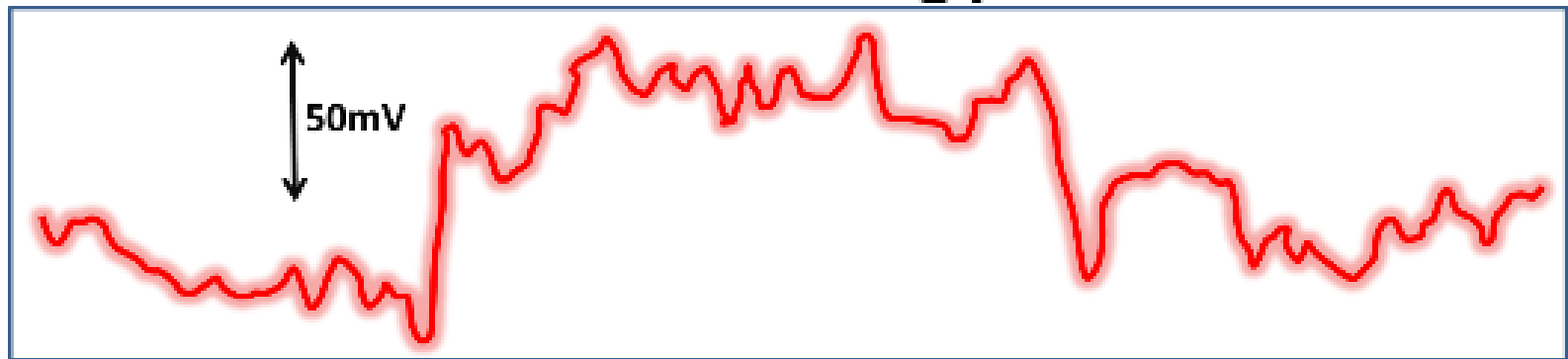
Alteration Voxet

# Kimberlite



# Spontaneous Potential

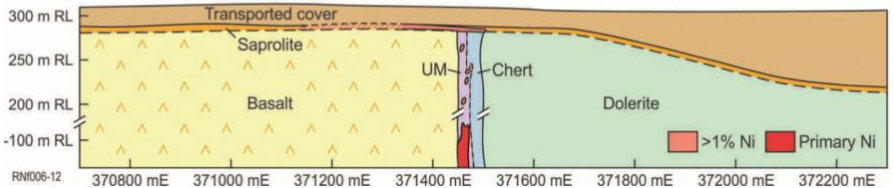
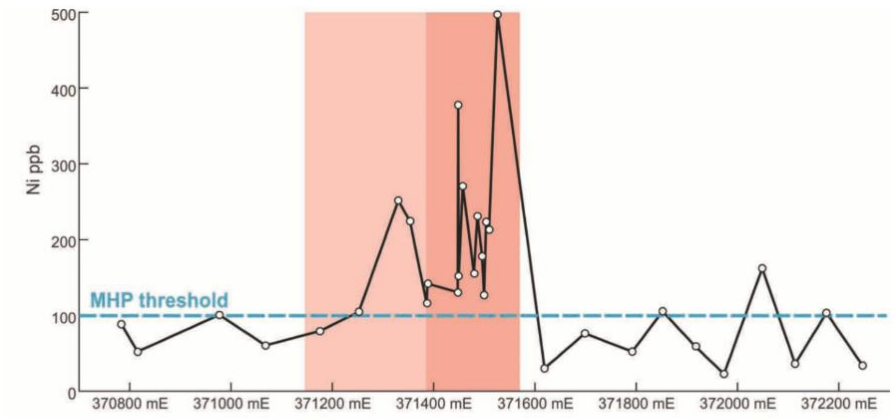
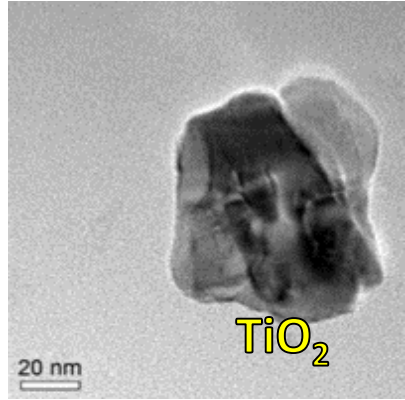
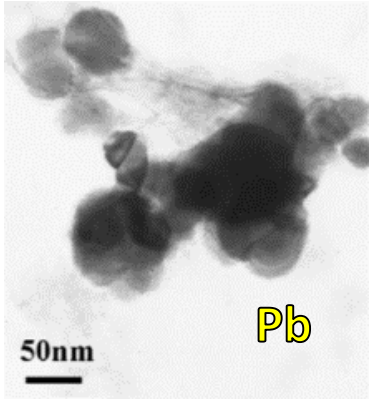
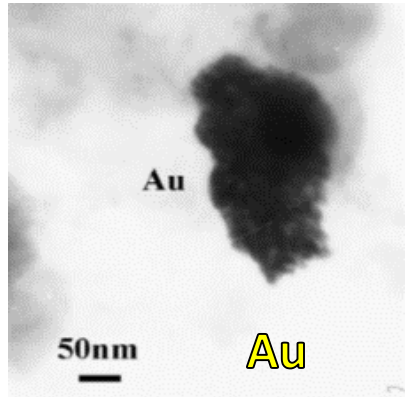
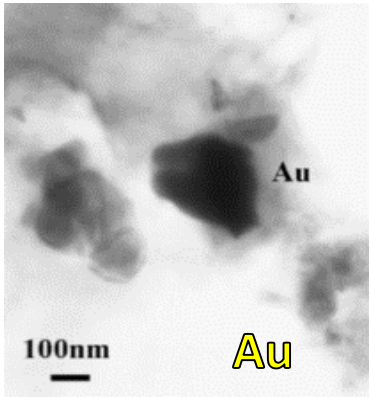
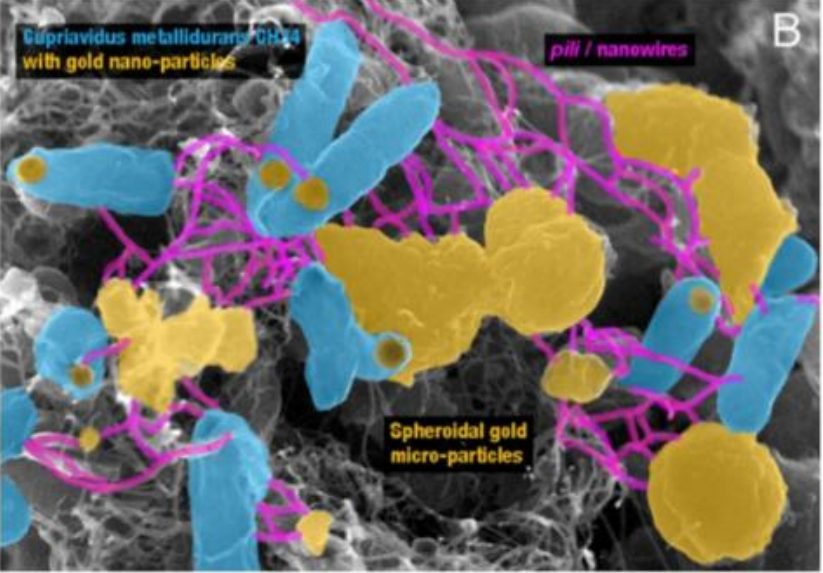
## Lithology



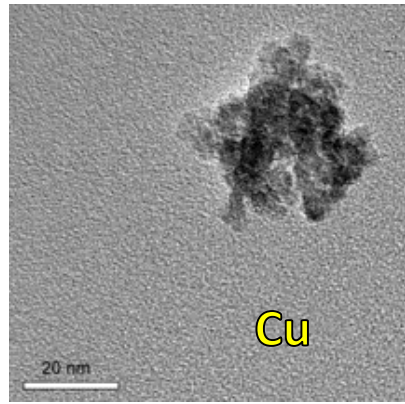
200 m

■ Pegmatite    ▨ Gneiss    ▨ Tertiary cover    | Probable boundaries of pegmatitic gneiss





Nano-particles extracted from soil



Noble, Lintern, Townley, Anand, Gray, & Reid (2013). Metal migration at the North Miitel Ni sulphide deposit in the southern Yilgarn Craton: Part 3, gas and overview GEEA 99-113

# Lithological Changes undercover

- Geological boundaries produce redox boundaries
- Reflected at the surface:
  - Spontaneous Potential
  - Eh, Ph
  - Inorganic
  - Organic
  - Bacteria
  - Isotopic
- Thickness of overburden ?



# The challenge

- Can we map the alteration through cover.
- Back to basics
- Identify and characterise the processes
  - Generation
  - Preservation
- Develop environment specific techniques and practises specifically for the responses.

Thank  
You

